GEOLOGY

PHYSIOGRAPHIC REGIONS

The watershed is located within the Interior Highlands physiographic province of the United States. The Missouri portion of the watershed lies almost entirely within the Salem Plateau region, a subdivision of the larger Ozark Plateau physiographic region, with a small portion of the watershed's northwest edge in the Springfield Plateau, also a subdivision of the Ozark Plateau. The Springfield Plateau is a region of lower relief than the Salem Plateau. The Arkansas portion of the watershed also lies within the Salem Plateau and Springfield Plateau physiographic regions, and its southern-most edge is in the Boston Mountains physiographic region (Fenneman 1938).

Major drainages in the Salem Plateau are characterized by rolling uplands with local relief of 100 to 200 feet. Smaller streams are characterized by narrow valleys from 200 to 500 feet deep. The Salem Plateau has an average elevation range of 1,000 to 1,400 feet mean sea level (msl). Elevations in the eastern-most portion of the Springfield Plateau reach heights of 1,700 feet msl, and relative relief of streams reaches a maximum of 400 feet. The Boston Mountains region has local relief up to 1,000 feet in smaller stream valleys with a maximum elevation nearing 2,300 ft. msl. The Eureka Springs (Burlington) escarpment, a narrow belt of hills extending from the Osage Plain on the north to the Arkansas state line on the south, separates the Salem and Springfield plateaus (MDNR 1986a).

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The uplands of the Salem Plateau are underlain by Jefferson City Dolomite and the Roubidoux Formation, and the valleys are floored by Gasconade Dolomite of Ordivician age. The Springfield Plateau is underlain by Mississippian limestones. The Boston Mountain Plateau is underlain by resistant clastic rocks of Pennsylvanian age. The Eureka Springs escarpment is the boundary between the Mississippian limestone of the Springfield Plateau and the Devonian limestone of the Salem Plateau. The geology underlying the watershed is shown in Figure GE01.

The large dolomite mass which is present in the Ozarks has tremendous water storing capability, and the Salem Plateau is the locality for the greatest number and largest springs in Missouri, followed secondly by the Springfield Plateau. The large reservoirs in the southern part of the watershed probably cover many springs. Springs of the watershed are listed in Table GE01 and Figure GE02. Karst features are locally prominent in both the Salem and Springfield plateaus (MDNR 1986a). Several faults are present in the watershed, but most have only tens of feet of displacement (MDNR 1986a). The fractured limestone of the watershed allows a direct linkage from surface waters to ground waters, making aquifers underlying the watershed extremely susceptible to contamination (USGS 1996).

SOIL TYPES

Soils in the Missouri portion of the watershed are of the Ozark type. The major soil association is Gasconade-Opequon-Clarksville, found in the western and central portions. A Captina-Clarksville-Doniphan association is present on the watershed's eastern edge. Other minor soil associations include Nixa-Clarksville, along the Missouri-Arkansas border, and Needleye-Viration-Wilderness, near the northwest corner (Allgood and Persinger 1979).

Captina-Clarksville-Doniphan soils are found on level to very steep slopes, moderately to excessively well drained. These are loamy upland soils with fragipans that are cherty throughout (Allgood and Persinger 1979).

Nixa-Clarksville soils are found on gently sloping to very steep slopes, and are moderately well drained to somewhat excessively drained upland soils with fragipans or cherty subsoils (Allgood and Persinger 1979).

Needleye-Viration-Wilderness soils are found on nearly level to moderately steep slopes. These are moderately well drained, loamy upland soils containing fragipans (Allgood and Persinger 1979).

Soils in the Arkansas portion of the watershed are also Ozarkian. Major soil associations include Clarksville-Nixa-Noark, Captina-Nixa-Tonti, and Arkana-Moko in the Salem and Springfield plateaus and Linker-Mountainburg-Sidon and Enders-Nella-Mountainburg-Steprock in the Boston Mountains (USDA-SCS 1982a).

Clarksville-Nixa-Noark soils are found on ridgetops and side slopes of the Springfield Plateau formed from cherty limestone. They range from excessively drained to moderately permeable, are found on gently sloping to very steep terrain and are very cherty, loamy upland soils (USDA-SCS 1982a).

Captina-Nixa-Tonti soils are found on broad uplands of the Springfield Plateau, ranging from moderately well drained to very slowly permeable. They are found on nearly level to moderately sloping areas and are cherty to loamy (USDA-SCS 1982a) .

Arkana-Moko soils are found on the ridgetops and side slopes of the Springfield and Salem plateaus, formed from cherty limestone and cherty dolomite. These soils are characterized as being moderately deep and shallow, well drained, and very slowly to moderately permeable. This soil type is found on gently sloping to very steep terrain and is very cherty and stoney (USDA-SCS 1982a).

Linker-Mountainburg-Sidon soils are found on benches, sides, and tops of mountains formed in loamy residuum from sandstone or interbedded sandstone, siltstone, and shale. They are moderately well to well drained, nearly level to steep, loamy, gravely, or stoney soils on uplands (USDA-SCS 1982a).

Enders-Nella-Mountainburg-Steprock soils are found on benches, sides, tops, and foot slopes of hills and mountains, formed in a thin layer of loamy colluvial material and clayey residuum from shale or interbedded shale, siltstone, and sandstone. They are well drained, deep to shallow, very slowly to moderately rapidly permeable soils, and are found on gently sloping to steep terrain (USDA-SCS 1982a).

Soil associations and information, at the local level, can be obtained through county Natural Resources Conservation Service (NRCS) offices throughout the watershed.

Ozark soils vary widely in character. Some soils are infertile stoney-clay type soils, while others are loess-capped and fertile. Some watershed soils are stone free, while others may have a stone content exceeding 50 percent, and some areas may have no soils covering bedrock. The majority of the watershed is dominated by stoney, cherty soils found on steep slopes with lower stone contents found in soils on more level areas. Soils in Missouri become less stoney on the western fringe of the watershed. Soils in the watershed are formed from residue high in iron, which oxidizes on exposure, giving the soil a red color. Soils formed in the residuum from cherty limestone or dolomite, range from deep to shallow and contain a high percentage of chert in most places. Soils formed in a thin mantle of loess are found on the ridges and have fragipans, which restrict root penetration. Soils formed in loamy, sandy, and cherty alluvium are found in narrow bottomland areas, and are the most fertile soils in the watershed (Allgood and Persinger 1979).

Soils in the watershed are generally acidic and of moderate to low fertility. Productivity of watershed soils varies widely, with forest and grassland being the dominant land cover (USDA-

SCS 1975). A typical watershed landscape consists of broad forested areas on moderately steep to very steep slopes and small pastures and cultivated fields on smoother ridgetops and in level valley bottoms. Tall fescue is the main grass used for pastures. Native, tall and midtall grasses are found in glade and savannah areas. They are less common than before European settlement (Allgood and Persinger 1979). The moisture holding capacity of these soils is limited, adding to the general unsuitability for crop production. (USDA-SCS 1975).

Soil erosion in the Missouri portion of the watershed is minimal relative to other areas in the state. Sheet and rill erosion on tilled land is 18-24 tons per acre, but totals across the watershed should be very low considering the small portion of the area in cultivation. Sheet and rill erosion for permanent pasture is 5-9 tons per acre. Sheet and rill erosion for non-grazed forest is 0.25-0.50 tons per acre. The gully erosion problems are considered slight, and problems associated with erosion are localized (0-100 tons per sq. mi.). The amount of sediment that reaches streams is estimated to be between 0.8-0.9 tons per acre annually (Anderson 1980).

STREAM ORDER

The White River is a sixth order stream where it enters Missouri in southeastern Barry County. The White becomes a seventh order stream at its confluence with the Kings River and an eighth order river shortly afterwards at the confluence with the James River. Today these order changes have little to do with size or flow increases within Missouri since both reaches are now impounded by Table Rock Dam. The White River remains an eighth order river where it enters the Mississippi River.

WATERSHED AREA

The entire White River basin comprises an area of 27,765 square miles. The portion of the White River covered by this document has an area of 5,184 square miles, making up 18.7 percent of the entire White River basin. The Missouri portion of the watershed includes 2,281 square miles (44%), and the Arkansas portion of the watershed includes 2,903 square miles (56%).

CHANNEL GRADIENT

Stream gradient information has been calculated for all streams third order and larger in the Missouri portion of the watershed. This information is available from MDC's Southwest Regional Office in Springfield, MO.

Figure GE01. Geology of the White River watershed.

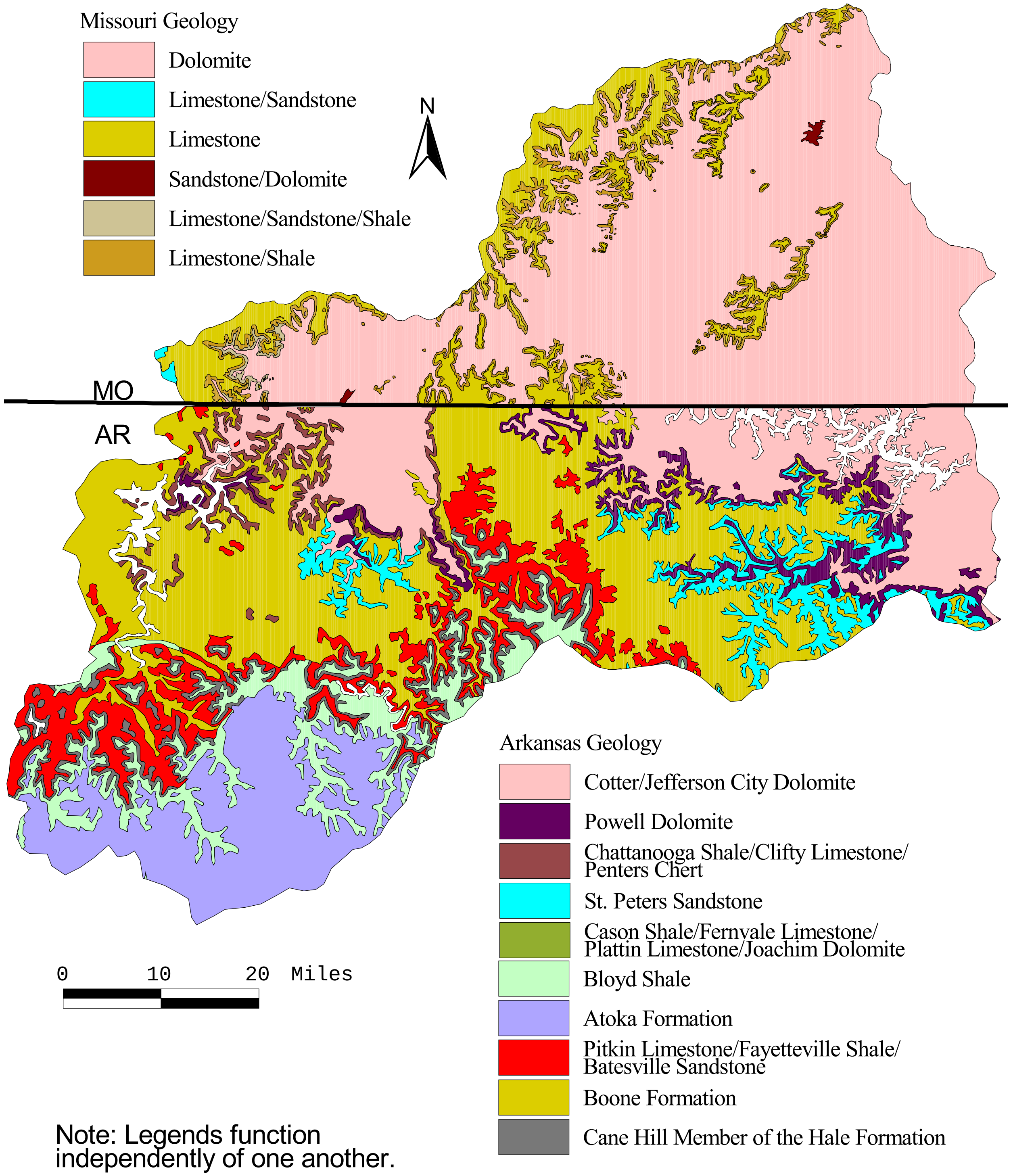


Table GE01. Springs of the White River watershed.

Spring #	Spring Name*	County	Topographic map	Flow **	Location T R S
03	Avery Spring	Stone	Blue Eye		21N 23W 24
49	Basin Spring	Carroll	Alpena		19N 22W 18
14	Beaver Creek Spring	Taney	Forsyth	65	23N 19W 15
102	Big Spring	Carroll	Carrollton		18N 22W 16
113	Blue Spring	Carroll	Blue Eye		21N 23 W 08
106	Blue Spring	Carroll	Busch		21N 27W 26
15	Boiling Spring	Douglas	Rome	19	25N 17W 05
104	Braswell	Carroll	Green Forest		20N 24W 25
08	Brown Spring	Christian	Shady Grove		26N 20W 08
06	Bud Spring	Christian	Green Mound Ridge		25N 21W 07
74	Bull Spring	Carroll	Alpena		19N 22W 18
96	Burchette Spring	Madison	Asher		15N 28W 13
09	Cash Spring	Christian	Christian Center		26N 20W 28
04	Devil’s Pool	Taney	Oakmont		21N 22W 12
62	Diamond Spring	Benton	Rogers		19N 29W 07
64	Electric Springs	Benton	Rogers		19N 29W 06
16	Falls Spring	Christian	Keltner		26N 18W 07
60	Frisco Springs	Benton	Rogers		19N 29W 33
112	Hale Spring	Carroll	Oak Grove		21N 23W 17
110	Hammond Spring	Carroll	Green Forest		20N 23W 08
10	Harmon Spring	Christian	Keltner		26N 19W 36
68	Hewitt Spring	Washington	Springdale		17N 29W 04
07	Jackson Spring	Christian	Christian Center		26N 21W 26
17	Jackson Mill Spring	Douglas	Ava	1,540	26N 17W 35
72	Johnson Spring	Carroll	Berryville		19N 25W 24
108	Mac Merry Spring	Carroll	Beaver		21N 27W 10
105	Magnetic Spring	Carroll	Eureka Springs		20N 26W 10
66	Mayo Spring	Benton	Rogers		19N 29W 11
13	Owens Spring	Taney	Ocie		22N 17W 26
76	Patty Spring	Carroll	Alpena		19N 22W 17
02	Radium Spring	Barry	Eagle Rock		21N 27W 23
05	Reno Spring	Christian	Chestnutridge		25N 27W 36
78	Reeves Spring	Carroll	Alpena		19N 23W 12
01	Roaring River Spring	Barry	Cassville	20,400	20N 27W 27
18	Rock Spring	Taney	Ocie	65	23N 17W 24
79	Rock Springs	Boone	Batavia		19N 21W 34
12	Schoolhouse Spring	Taney	Ocie		22N 17W 35
77	Sycamore Spring	Boone	Alpena		19N 22W 12
73	Tanyard Spring	Carroll	Alpena		19N 22W 19
11	Twin Springs	Taney	Ocie		22N 17W 26

Table GE01. Springs (continued).

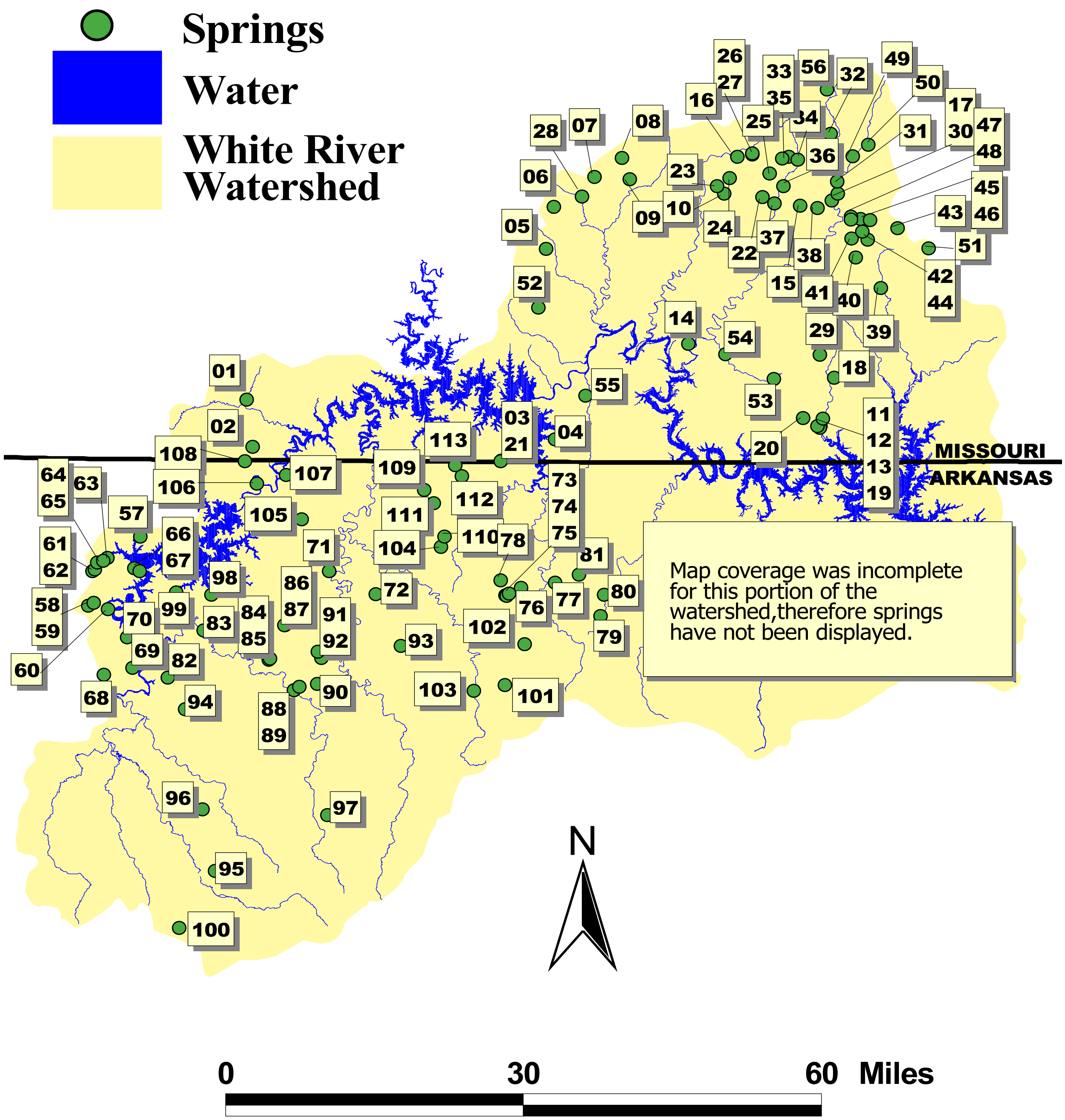
Spring #	Spring Name*	County	Topographic map	Flow **	Location T R S
19	Unnamed	Taney	Ocie		22N 17W 26
20	Unnamed	Taney	Ocie		22N 17W 27
21	Unnamed	Stone	Blue Eye		21N 23W 25
22	Unnamed	Douglass	Ava		26N 18W 34
23	Unnamed	Christian	Keltner		26N 19W 26
24	Unnamed	Christian	Keltner		26N 18W 19
25	Unnamed	Douglas	Keltner		26N 18W 23
26	Unnamed	Christian	Keltner		26N 18W 09
27	Unnamed	Christian	Keltner		26N 18W 09
28	Unnamed	Christian	Keltner		25N 21W 03
29	Unnamed	Taney	Ocie		23N 17W 23
30	Unnamed	Douglas	Keltner		26N 17W 36
31	Unnamed	Douglas	Keltner		26N 17W 23
32	Unnamed	Douglas	Keltner		27N 17W 26
33	Unnamed	Douglas	Keltner		26N 17W 07
34	Unnamed	Douglas	Keltner		26N 17W 08
35	Unnamed	Douglas	Good Hope		26N 18W 12
36	Unnamed	Douglas	Good Hope		26N 18W 25
37	Unnamed	Douglas	Good Hope		25N 18W 02
38	Unnamed	Douglas	Good Hope		25N 17W 03
57	Unnamed	Benton	Rogersville		20N 29W 24
58/59	Unnamed (2)	Benton	Rogers		19N 29W 31
61	Unnamed	Benton	Rogers		19N 29W 07
63	Unnamed	Benton	Rogers		19N 29W 04
65	Unnamed	Benton	Rogers		19N 29W 05
67	Unnamed	Benton	Rogers		19N 29W 12
69	Unnamed	Washington	Springdale		18N 29W 35
70	Unnamed	Benton	Springdale		18N 29W 14
80	Unnamed	Boone	Batavia		19N 21W 14
81	Unnamed	Boone	Batavia		19N 21W 05
82	Unnamed	Washington	Sonora		17N 28W 04
83	Unnamed	Benton	Clifty		18N 28W 12
84/85	Unnamed (2)	Madison	Clifty		18N 26W 30
86/87	Unnamed (2)	Madison	Clifty		18N 26W 04
39	Unnamed	Ozark	Squires		24N 16W 14
40	Unnamed	Douglas	Squires		25N 16W 32
41	Unnamed	Douglas	Squires		25N 16W 19
42	Unnamed	Douglas	Squires		25N 16W 21
43	Unnamed	Douglas	Squires		25N 16W 13

Table GE01. Springs (continued).

Spring #	Spring Name*	County	Topographic map	Flow **	Location T R S
44	Unnamed	Douglas	Squires		25N 16W 17
45	Unnamed	Douglas	Squires		25N 16W 08
46	Unnamed	Douglas	Squires		25N 16W 09
47	Unnamed	Douglas	Squires		25N 16W 09
48	Unnamed	Douglas	Squires		25N 16W 09
49	Unnamed	Douglas	Ava		26N 16W 06
50	Unnamed	Douglas	Ava		27N 16W 33
51	Unnamed	Douglas	Squires		25N 15W 28
107	Unnamed	Carroll	Beaver		21N 26W 21
52	Unnamed	Taney	Branson		24N 22W 34
53	Unnamed	Taney	Fairview		22N 18W 06
54	Unnamed	Taney	Hilda		23N 18W 20
55	Unnamed	Taney	Hollister		22N 21W 16
111	Unnamed	Carroll	Oak Grove		21N 24W 36
56	Unnamed	Douglas	Seymour		27N 17W 03
88	Unnamed	Madison	Huntsville		17N 26W 10
90	Unnamed	Madison	Huntsville		17N 26W 01
91	Unnamed	Madison	Forum		18N 26W 25
92	Unnamed	Madison	Forum		18N 26W 24
93	Unnamed	Carroll	Rudd		18N 24W 17
94	Unnamed	Washington	Goshen		17N 28W 23
95	Unnamed	Madison	Delaney		14N 27W 18
97	Unnamed	Madison	Huntsville		15N 26W 13
98	Unnamed	Benton	Rock		19N 27W 19
99	Unnamed	Benton	Rock		19N 27W 22
100	Unnamed	Madison	Delaney		13N 28W 15
101	Unnamed	Carroll	Osage		17N 22W 06
103	Unnamed	Carroll	Osage		17N 23W 10
71	Winona Springs	Carroll	Eureka Springs		19N 25W 06
89	Withrow Springs	Madison	Huntsville		17N 26W 10
109	Wood Spring	Carroll	Berryville		21N 24W 26

* The number (N) with the spring name indicates two springs at one location.
**Flow in thousand gallons per day. Source: Vineyard (1982) and 7.5 minute USGS topographic maps.

Figure GE02. Springs of the White River watershed



Note: Spring numbers reference Table GE01.

Source: USGS 7.5 minute topographic maps and Vineyard (1982).